

A 10-Year Regional Assessment of Macrofaunal Assemblages off the Coast of San Diego

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INTRODUCTION

The City of San Diego has conducted regional benthic surveys of the continental shelf and slope off San Diego since 1994. The main objectives of these surveys are: (1) to characterize benthic conditions for the large and diverse coastal region off San Diego; (2) to characterize the ecological health of the marine benthos in the area; (3) to identify areas impacted by anthropogenic or natural events. A summary of the analyses of the first 10 years of data collected and an assessment of the overall status of the macrobenthos are presented.

METHODS

Macrofauna samples were collected annually from 1994–2003 using the USEPA probability-based EMAP random sampling design. The study area ranged from off Del Mar in northern San Diego County south to the US/Mexico border. A total of 324 different sites, ranging in depth from 9 to 461 m, were sampled during this 10-year period. Patterns of macrobenthic community structure and various environmental parameters were addressed using univariate and multivariate statistics.

RESULTS

A total of 1341 species and 107,863 individuals were collected and identified during the 10-year random sampling survey. Infaunal abundances ranged from 39 to 1467 individuals per sample (mean=317) and the total number of species ranged from 21 to 266 per sample (mean=101 species).

Although variable, benthic communities off the coast of San Diego generally have remained similar over time. A drop in abundance, diversity, and species richness in 2003 was due to inclusion of 5 stations located in deeper water (cluster group A) not sampled in previous years (Figure 1).

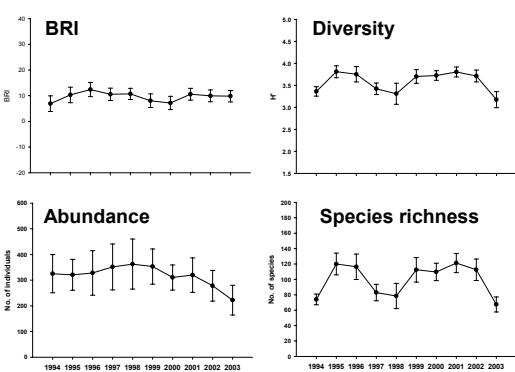


Figure 1
Comparison of several parameters at stations sampled off the coast of San Diego from 1994–2003. Data are expressed as means per $0.1 \text{ m}^2 \pm 95\%$ CI ($n > 26$ per year).

Classification analyses discriminated differences among 10 main assemblage types (cluster groups A–J) between 1994–2003 (Figure 2). MDS ordination of the survey entities confirmed the validity of the major cluster groups (Figure 3). Assemblages clustered spatially within major depth contours and sediment types associated with variations in seafloor topography. Polychaetes and ophiuroids were the most dominant taxa off San Diego. Abundant species are listed by depth in Table 1 and by cluster group in Table 2.

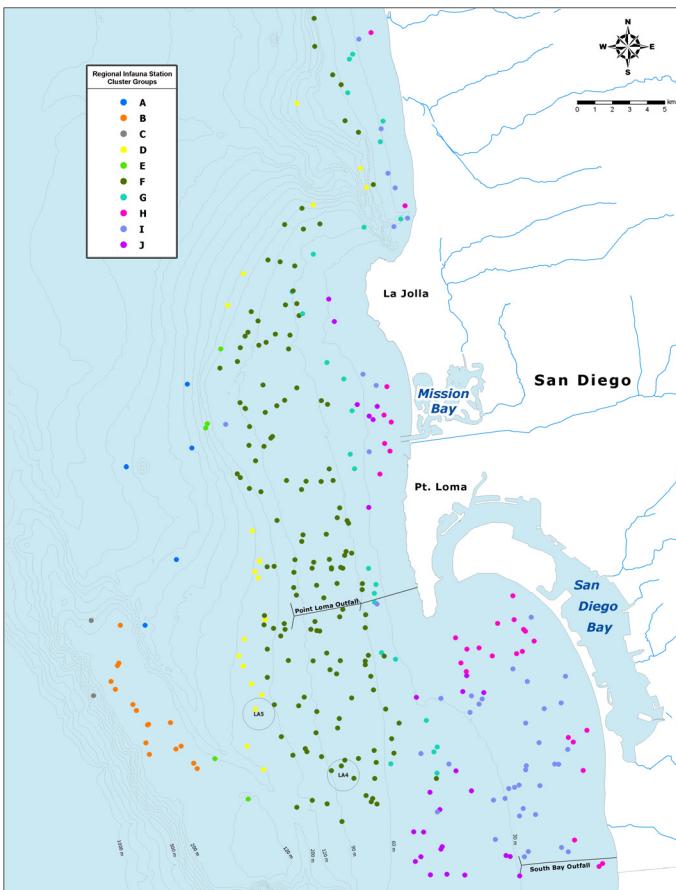


Figure 2
Results of ordination and classification analyses of macrofaunal abundance between 1994–2003. Cluster groups are color-coded to reveal spatial patterns in the distribution of benthic assemblages.

Species/taxa	Higher taxa	Depth range				
		Inshore (<30m)	Mid-shelf (30–120m)	Deep shelf (120–200m)	Slope (>200m)	
<i>Amphiodia urtica</i>	Echinodermata: Ophiuroidea	0.1	46.1	3.7	—	
<i>Myriochela striolata</i>	Polychaeta: Oweniidae	1.0	42.3	2.3	0.3	
<i>Spiophanes duplex</i>	Polychaeta: Spionidae	3.3	20.3	2.9	—	
<i>Spiophanes kimballi</i>	Polychaeta: Spionidae	—	2.2	14.9	0.2	
<i>Pectinaria californiensis</i>	Polychaeta: Pectinariidae	1.5	10.8	3.6	1.0	
<i>Spiophanes bombyx</i>	Polychaeta: Spionidae	11.5	3.0	0.4	—	
<i>Paradiopatra parva</i>	Polychaeta: Onuphiidae	—	3.5	9.0	1.6	
<i>Owenia collaris</i>	Polychaeta: Oweniidae	10.7	0.3	—	—	
<i>Maldane sarsi</i>	Polychaeta: Maldanidae	—	0.6	1.3	7.3	
<i>Amphiodia digitata</i>	Echinodermata: Ophiuroidea	0.2	1.1	4.1	3.8	
<i>Caecum crebricinctum</i>	Mollusca: Gastropoda	2.0	1.9	4.0	0.2	
<i>Tellina cadieri</i>	Mollusca: Bivalvia	—	0.3	2.4	4.6	

Table 1

Mean abundance per sample (no./ 0.1 m^2) of the most abundant taxa collected per depth range. Animals absent from a depth range are indicated by a dash.

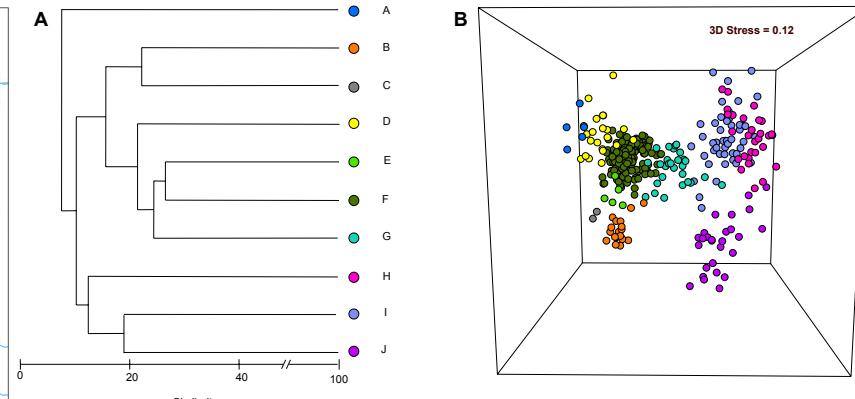


Figure 3
(A) Cluster results of the macrofaunal abundance data for stations sampled between 1994–2003. Data are expressed as mean values per 0.1 m^2 grab over all stations in each group. (B) MDS ordination of the same benthic stations based on square-root transformed macrofaunal abundance data for each station/survey entity. Cluster groups superimposed on station/surveys illustrate a clear distinction among major faunal assemblages.

Species/taxa	Higher taxa	Cluster groups									
		A	B	C	D	E	F	G	H	I	J
<i>Amphiodia digitata</i>	Echinodermata: Ophiuroidea	1.0	7.2	7.5	0.9	17.8	1.1	1.4	0.1	0.3	—
<i>Amphiodia sp</i>	Echinodermata: Ophiuroidea	0.2	1.3	2.0	0.7	3.6	27.2	2.4	0.2	0.5	0.4
<i>Amphiodia urtica</i>	Echinodermata: Ophiuroidea	—	—	—	2.8	0.6	57.9	5.0	—	0.1	0.1
<i>Amphiuriidae</i>	Echinodermata: Ophiuroidea	4.0	3.4	1.5	1.6	8.4	13.6	2.3	0.4	1.1	0.9
<i>Apionsoma misakianum</i>	Sipuncula: Phascolosomatidae	—	—	—	0.2	0.1	9.4	—	0.9	0.8	—
<i>Caecum crebricinctum</i>	Mollusca: Gastropoda	—	9.4	—	—	18.6	—	6.0	0.1	0.1	11.7
<i>Chloea pinnata</i>	Polychaeta: Amphionidae	0.2	9.2	12.0	0.7	2.6	2.2	6.3	—	—	0.6
<i>Compressidens steamsii</i>	Mollusca: Scaphopoda	4.4	—	2.0	0.3	—	—	—	—	—	—
<i>Fauvellopsis sp</i>	Polychaeta: Fauvellopsidae	4.0	—	1.0	—	—	—	—	—	—	—
<i>Leptochelia dubia</i>	Crustaceae: Tanaidacea	—	10.7	1.0	0.0	5.6	1.9	3.8	0.1	0.7	2.7
<i>Maldane sarsi</i>	Polychaeta: Maldanidae	12.8	—	—	2.8	0.4	0.7	0.6	—	—	—
<i>Maldanidae sp</i>	Polychaeta: Maldanidae	0.4	0.3	0.5	2.7	2.4	3.7	7.1	0.3	2.8	1.0
<i>Mediomastus sp</i>	Polychaeta: Capitellidae	0.2	0.6	5.5	3.0	8.2	2.2	5.1	0.9	4.3	0.3
<i>Monticellina sibilla</i>	Polychaeta: Cirratulidae	—	2.1	1.0	0.1	3.0	0.6	13.3	0.5	5.4	0.4
<i>Myriochela striolata</i>	Polychaeta: Oweniidae	0.6	0.2	—	0.2	1.4	51.1	15.1	0.1	1.7	0.2
<i>Nuculana conceptionis</i>	Mollusca: Bivalvia	4.2	—	—	—	—	—	—	—	—	—
<i>Owenia collaris</i>	Polychaeta: Oweniidae	—	—	—	—	0.2	0.6	26.1	1.8	0.8	—
<i>Paradiopatra parva</i>	Polychaeta: Onuphiidae	—	0.7	1.0	8.7	9.8	5.7	1.6	0.1	0.1	—
<i>Pectinaria californiensis</i>	Polychaeta: Pectinariidae	0.2	1.3	—	4.0	10.0	13.1	3.8	3.6	0.4	0.3
<i>Phoronis sp</i>	Phorona: Phoronidae	—	0.1	—	0.1	0.2	4.3	12.9	1.4	0.9	1.6
<i>Spiophanes berkeleyorum</i>	Polychaeta: Spionidae	—	0.1	—	0.9	21.4	2.8	5.2	—	1.1	0.4
<i>Spiophanes bombyx</i>	Polychaeta: Spionidae	—	0.2	—	0.9	—	0.2	4.4	9.5	10.3	21.4
<i>Spiophanes duplex</i>	Polychaeta: Spionidae	—	2.7	—	1.7	2.0	20.5	27.3	2.7	4.7	1.4
<i>Spiophanes kimballi</i>	Polychaeta: Spionidae	—	0.2	—	20.5	1.6	5.0	0.2	—	—	—
<i>Tellina cadieri</i>	Mollusca: Bivalvia	6.0	2.4	3.5	2.0	2.2	0.7	0.1	—	—	—

Table 2

Summary of the most abundant taxa composing cluster groups A–J from stations surveyed between 1994–2003. Data are expressed as mean abundance per sample (no./ 0.1 m^2). Animals absent from a cluster group are indicated by a dash.

SUMMARY

Cluster analysis and ordination of sites discriminated between 10 habitat-related macrobenthic assemblages off San Diego from 1994 through 2003. These assemblages were stratified along depth contours, but displayed no spatial patterns relative to point source inputs. Benthic communities in the region remained dominated by ophiuroid-polychaete based assemblages throughout this period, with few major changes occurring since monitoring began. Although the results from univariate analyses varied, values for most community parameters were comparable to historical values recorded elsewhere for the Southern California Bight. Overall, these data suggest that the structure of benthic communities off San Diego has not changed substantially in recent years.